

What is claimed is:

- 1 1. A coder comprising:
  - 2 an obtaining unit that obtains a predetermined
  - 3 amount of image data in which each pixel is expressed by a
  - 4 plurality of bits;
  - 5 a developing unit that develops the pieces of bit
  - 6 data in the image data on virtual planes, wherein pieces
  - 7 of bit data of the same pixel are developed on the same
  - 8 virtual plane; and
  - 9 a coding unit that performs entropy coding on the
  - 10 developed bit data in virtual plane units.
- 1 2. The coder according to Claim 1, wherein the pixel
- 2 is expressed by 8 bits.
- 1 3. The coder according to Claim 2, wherein the
- 2 developing unit develops pieces of bit data of each pixel
- 3 in a 2 bit by 4 bit matrix.
- 1 4. The coder according to Claim 1, wherein the
- 2 predetermined amount of image data is image data
- 3 corresponding to one page.
- 1 5. The coder according to Claim 1, wherein the coding
- 2 unit obtains a probability value of a target bit from

3 reference bits and performs an arithmetic coding with  
4 prediction according to the obtained probability value,  
5 wherein the target bit is a subject of coding and the  
6 reference bits are in predetermined positions relative to  
7 the target bit.

1 6. The coder according to Claim 1, wherein the  
2 developing unit performs code conversion on the  
3 predetermined amount of image data before developing the  
4 pieces of bit data.

1 7. The coder according to Claim 6, wherein binary  
2 data is converted to gray codes in the code conversion.

1 8. A coder comprising:  
2 an obtaining unit that obtains a predetermined  
3 amount of image data in which each pixel is expressed by a  
4 plurality of bits;  
5 a BTC (Block Truncation Coding) processing unit  
6 that performs BTC processing on the obtained image data to  
7 obtain gradation characteristic data and quantized data;  
8 a developing unit that develops pieces of bit data  
9 in the obtained gradation characteristic data on virtual  
10 planes; and  
11 a coding unit that performs entropy coding on the  
12 developed bit data in virtual plane units.

1 9. The coder according to Claim 8, wherein the  
2 developing unit performs code conversion on the obtained  
3 gradation characteristic data before developing the pieces  
4 of bit data.

1 10. A coding method comprising:  
2 an obtaining step for obtaining a predetermined  
3 amount of image data in which each pixel is expressed by a  
4 plurality of bits;  
5 a developing step for developing the pieces of bit  
6 data in the image data on virtual planes, wherein pieces  
7 of bit data of the same pixel are developed on the same  
8 virtual plane; and  
9 a coding step for performing entropy coding on the  
10 developed bit data in virtual plane units.

1 11. A coder comprising:  
2 an obtaining unit that obtains a predetermined  
3 number of pixels of multivalued image data;  
4 a BTC processing unit that generates gradation  
5 characteristic data and quantized data from pixel values  
6 of the pixels of the obtained multivalued image data;  
7 a developing unit that develops pieces of bit data  
8 in the gradation characteristic data on first virtual  
9 planes; and

10           a coding unit that performs entropy coding on the  
11 developed bit data in first virtual plane units.

1 12.       The coder according to Claim 11, wherein  
2           the developing unit develops pieces of bit data in  
3 the quantized data on at least one second virtual plane,  
4 and

5           the coding unit performs the entropy coding on the  
6 developed bit data in the quantized data in second virtual  
7 plane units.

1 13.       The coder according to Claim 12, wherein each  
2 piece of the quantized data corresponding to a different  
3 one of the pixels includes a plurality of pieces of bit  
4 data,

5           the coder further comprising a dividing unit that  
6 divides the pieces of bit data in the quantized data into  
7 a plurality of groups, wherein the developing unit  
8 develops pieces of bit data in the quantized data in a  
9 different group on a different virtual plane.

1 14.       The coder according to Claim 13, wherein the  
2 plurality of groups are a first group of upper bit data  
3 and a second group of lower bit data.

1 15.       The coder according to Claim 13, wherein

2           the predetermined number of pixels indicates a  
3 block of 4 pixels \* 4 pixels, and  
4           the developing unit develops pieces of bit data in  
5 each of the groups obtained from each block of the  
6 multivalued image data in a 4 bit by 4 bit matrix.

1 16.       The coder according to Claim 12, wherein each  
2 piece of the quantized data corresponding to a different  
3 one of the pixels includes a plurality of pieces of bit  
4 data,

5           the coder further comprising:  
6           a compression ratio obtaining unit that obtains a  
7 compression ratio for the entropy coding; and  
8           a judging unit that judges whether another  
9 quantized data is necessary according to the compression  
10 ratio.

1 17.       The coder according to Claim 11, wherein the  
2 developing unit performs code conversion on the pieces of  
3 bit data in the gradation characteristic data before  
4 developing the pieces of bit data in the gradation  
5 characteristic data.

1 18.       The coder according to Claim 17, wherein binary  
2 data is converted to gray codes in the code conversion.

1 19. The coder according to Claim 11, wherein each  
2 pixel is expressed by 8 bits in the multivalued image  
3 data.

1 20. The coder according to Claim 11, wherein the  
2 predetermined number of pixels indicates a block of 4  
3 pixels \* 4 pixels.

1 21. The coder according to Claim 20, wherein the  
2 developing unit develops the pieces of bit data in the  
3 gradation characteristic data obtained from each block of  
4 the multivalued image data in a 4 bit by 4 bit matrix.

1 22. The coder according to Claim 11, further  
2 comprising a converting unit that converts the quantized  
3 data into a predetermined bit string, wherein the coding  
4 unit performs the entropy coding on the bit string.

5 23. A coding method comprising:  
6 an obtaining step for obtaining a predetermined  
7 number of pixels of multivalued image data;  
8 a BTC processing step for performing BTC  
9 processing on pixel values of the pixels of the obtained  
10 multivalued image data and generating gradation  
11 characteristic data and quantized data;  
12 a developing step for developing pieces of bit

13 data in the gradation characteristic data on virtual  
14 planes; and  
15 a coding step for performing entropy coding on the  
16 developed bit data in virtual plane units.

1 24. An image forming apparatus comprising:  
2 a coder that includes:  
3 an obtaining unit that obtains a predetermined  
4 amount of image data in which each pixel is expressed by a  
5 plurality of bits;  
6 a developing unit that develops the pieces of bit  
7 data in the image data on virtual planes, wherein pieces  
8 of bit data of the same pixel are developed on the same  
9 virtual plane;  
10 a coding unit that performs entropy coding on the  
11 developed bit data in virtual plane units;  
12 a decoder that decodes data that has been coded by  
13 the coder and reconstructs image data; and  
14 an image forming unit that forms an image using  
15 the image data that has been reconstructed by the decoder.

1 25. An image forming apparatus comprising:  
2 a coder that includes:  
3 an obtaining unit that obtains a predetermined  
4 number of pixels of multivalued image data;  
5 a BTC processing unit that generates gradation

6 characteristic data and quantized data from pixel values  
7 of the pixels of the obtained multivalued image data;  
8 a developing unit that develops pieces of bit data  
9 in the gradation characteristic data on first virtual  
10 planes;

11 a coding unit that performs entropy coding on the  
12 developed bit data in first virtual plane units;

13 a decoder that decodes data that has been coded by  
14 the coder and reconstructs image data; and

15 an image forming unit that forms an image using  
16 the image data that has been reconstructed by the decoder.

1 26. A computer program that performs coding processing  
2 of image data has a computer execute steps, the steps  
3 comprising:

4 a developing step for developing on virtual planes  
5 pieces of bit data in image data in which each pixel is  
6 expressed by a plurality of bits, wherein pieces of bit  
7 data of the same pixel are developed on the same virtual  
8 plane; and

9 a coding step for performing entropy coding on the  
10 developed bit data in virtual plane units.

1 27. A computer program that performs coding processing  
2 of image data has a computer execute steps, the steps  
3 comprising:

4           an obtaining step for obtaining a predetermined  
5   number of pixels of multivalued image data;  
6           a BTC processing step for generating gradation  
7   characteristic data and quantized data from pixel values  
8   of a plurality of pixels of multivalued image data;  
9           a developing step for developing pieces of bit  
10   data in the gradation characteristic data on virtual  
11   planes; and  
12           a coding step for performing entropy coding on the  
13   bit data in virtual plane units.